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TRUTH IS MIGHTY

AND WILL PREVAIL.

Bees & Fruit.

Important Part Played by Bees in

The Fertilization of Blossoms.

SF 529
R78

EVIDENCE PRO AND CON.

The articles in this number formed the basis for a symposium in *Gleanings in Bee Culture*. It is here put in pamphlet form for handy distribution of bee-keepers among their fruit-growing neighbors who are inclined to ask for the removal of bees on the ground of alleged nuisance. A careful reading, it is hoped, will convince them that the bees are their friends.

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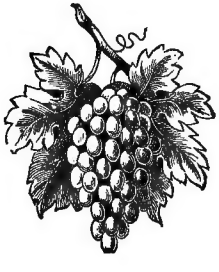

A. I. ROOT, MEDINA, O.

SYMPOSIUM ON BEES AND FRUIT.

Valuable Testimony Supporting the Bee.

A Lively Discussion, Pro and Con.

DO BEES FERTILIZE FRUIT-BLOSSOMS?

BOTH SIDES OF THE QUESTION.

[A short time ago there appeared in the *Rural New-Yorker* an excellent article from Dr. C. C. Miller, on bees and fruit, which was followed in a later issue by another article taking strong ground against what the doctor had said. We wrote to friend M., asking him if he were going to let the matter drop there. In reply we received the following note, asking information through GLEANINGS.—ED.]

The *Rural New-Yorker*, reliable paper that it is on all other subjects, had an item sneering at the idea that fruit-trees should not be sprayed when in bloom, suggesting that the bee-keeper should keep his bees at home. A reply was made, saying that, if the bee-keeper should keep his bees away, the fruit-grower wouldn't be troubled with spraying, for there wouldn't be enough fruit set to make it worth while to spray. Then L. E. R., of L., Nebraska, made a reply in which he says, "I lived several years in Wyoming; was engaged in the growing of vegetables, fruits, and flowers, for commercial purposes, and was in the seed business. We had no bees in that country until two years before I left there. We grew apples, crabs, raspberries, and strawberries, the latter in great quantities, of immense size and most excellent quality. Then our wild fruits—plums, cherries, and service-berries, bore year after year, the trees being literally loaded down with fruit. I left that favored clime, and came to what is termed the fruit-belt of Nebraska; but I want to tell you that we had more and better fruit in a day in Wyoming, where we had no bees to fertilize the blossoms, than I have seen here in two years, with an apiary at every second house."

I want to ask, through GLEANINGS, whether the experience and observation of others corroborate the foregoing statement. Were there no bees in Wyoming till four years ago? Did others have such crops of fruit as are mentioned, with no bees visiting the blossoms? We ought to seek the truth, whatever it may be, even if it upsets what has previously been supposed to be the truth. From my own observation, I have always supposed that bees aided the fertilization of pretty much all kinds of fruit; but I do not know that I ever saw them work to any extent on strawberries. Are they needed for strawberries? If any of our friends of Wyoming, or of the fruit-belt of Nebraska, can give us any light, I sha l be much obliged to have them write to me or to GLEANINGS.

Marengo, Ill. C. C. MILLER.

[The article in the *Rural*, together with a recent one by G. M. Doolittle, on page 915, GLEANINGS for Dec. 15, seems to have stirred up some little discussion among the brethren. Among others just received is the following, which we publish, not so much because it supports the side of the bee-keeper impartially, but because of the painstaking care the writer has used in obtaining the facts.]

BUMBLE-BEES AND CLOVER.

It is an idea often stated, that clover will not yield seed without the aid of bumble-bees, and that clover did not yield seed in Australia until bumble-bees were imported. I did not believe this, as plants were created first, and for the higher order of animal life, but so as to continue existence without animal aid. Therefore honey was primarily for the bee, and incidentally the bee helps the plant in gathering the honey. To find the facts, I made some observations and experiments.

In 1891 there were 1½ acres of medium red clover that came within 30 feet of my door, and, being confined to the house by sickness, I watched this field. There was the usual amount of rain until April 20; then there was no rain until June 1, so the clover-florets were shorter than usual, and the honey-bees worked on them as much as white clover. Still there were only few seeds. This clover was not a small growth, as it made two tons of dry hay per acre, first crop. When the second crop bloomed, there were the most bumble-bees I ever saw, as the best estimate I could make was that there was one to each ten feet square, making 4356 working at the same time on one acre. When the seed ripened, there was a large crop. This year, being still unable to walk, I rolled out into the yard in my wheel-chair, and made this experiment. July 21 I covered some clover-blossoms with netting. Part of the florets being open, I tied a small thread around the open ones. At the same time I gathered five heads of clover that were ripe, and 447 cap-

sules gave 131 seeds. The bumble-bees had worked on these blossoms, there being few flowers when they bloomed. Aug. 14 I gathered the covered blossoms, also some on some plants not covered. Where the numbers are the same, they are part of the same head of clover.

No. 1	48	florets	open when covered	gave	30	seeds, or	62.5 %
No. 1	67	"	not open " "	"	35	" "	52.238 %
No. 2	113	"	not covered	"	68	" "	60.177 %
No. 3	132	"	covered	"	100	" "	75.757 %
No. 4	145	"	not covered	"	123	" "	84 827 %
No. 5	63	"	open when covered	"	43	" "	68.254 %
No. 5	84	"	not open when covered	"	50	" "	71.428 %
No. 6	117	"	not covered	"	100	" "	85.47 %
No. 7	41	"	open when covered	"	31	" "	75.609 %
No. 7	85	"	not open when covered	"	36	" "	42 352 %
No. 8	140	"	covered	"	33	" "	23 571 %
No. 9	76	"	not covered	"	24	" "	31.578 %

Nos. 8 and 9 were on a plant about 50 feet from other clover-plants. Three heads, where 152 florets were open when covered, gave 104 seeds, or 68.421 %; 3 heads, where 236 florets were not open when covered, gave 111 seeds, or 47.033 %. Loss by covering, 21.388 %.

The total florets not covered, 527, gave 385 seeds, or 73.055 %. The total florets covered, 368, gave 211 seeds, or 57.337 %. Loss by covering, 15.718 %.

Alsike and peavine red clover yield seed from the first blossoms; therefore, it is the nature of the plant, and not lack of bees, that causes fewer seed in first blossoms of red clover. The later blossoms of red clover will yield seed without the aid of bumble-bees; but their work adds about 15 % to the yield. So the farmer who destroys all bumble-bees' nests is destroying a large part of his profit if he raises clover.

Bloomfield, Ind., Dec. 28. J. C. GILLILAND.

[This most valuable communication was followed again by a private letter from Mr. Doolittle, inclosing an article from Mr. W. S. Fultz, which the latter says we at one time refused to publish. We have no recollection of this; at any rate, as it seems to be a good one we are glad to give place to it at this time.]

ARE BEES NECESSARY TO THE PROPER FERTILIZATION OF FRUIT-BLOOM?

The assertion has often been made by horticultural journals and bee-papers, that the honey-bee is an essential to the perfect fertilization of fruit-bloom, and that, without the aid of bees, the fruit-grower could not carry on his business with any certainty of a crop, so that the public have got to believe that such is really the case. Bee-journals have been very persistent in asserting that, if there were no bees, there would be no fruit. This is especially the case whenever they hear of any fruit-grower charging that the bees have been destroying fruit.

In studying this question we naturally go back to the early history of the country, and we find that the first settlers of this country found in many places wild fruit growing in abundance. We also find that, in many parts of the country, there were nut-trees of various kinds that showered down their nuts each autumn, and that, within the almost boundless forests, there were trees of all sizes, from the tiny yearling to the giant monarch of the forest, showing conclusively that the nuts and seeds of the forest had been properly fertilized for centuries before the advent of the white man. History also informs us that the first white settlers of America found no honey-bees, and that the first bees introduced into this country came from Europe, and that they were the German or brown bee. What, then, was it that fertilized the wild-fruit bloom, the nut and other trees of the extensive forests of America, to say nothing of the corn, tobacco, and other crops that were raised by the Indians?

In discussing this question with bee-keepers they always refer me to the fact that there were bumble-bees, wasps, hornets, and other honey-gathering insects in the country; but when asked how many of these insects there were in each nest at the time when trees are usually in bloom, they were obliged to admit that the queen was the only one, and that it was utterly impossible that the extensive fertilization necessary could have been performed by them.

When the first settlers from the United States went to California they found various kinds of fruit growing there. Many of the old Spanish missions were noted for the fine fruits that were raised there. The same is also true of Oregon and Washington, and yet there were no honey-bees there. We have a true account of the first attempts that were made to introduce the honey-bee into the Pacific Slope. That account, if given, would make this paper too long, and is not germane to the subject. It is sufficient to say, that fruits of different kinds, both wild and cultivated, were raised without the aid of the honey-bee. I might here add that the Mormons found the same state of affairs to exist in Utah that the early American settlers found on the Pacific Slope. So much for history, now for personal observation.

The winter of 1871 will long be remembered by the bee-keepers of that time as one of great disaster. Fully 75 per cent of all the apiaries of Eastern Iowa and Western Illinois were wiped out of existence, and the others were so decimated that, in nearly every case, not more than three or four hives of bees were left, and those were very weak during the early part of the following summer. Several apiaries with which I was acquainted, that had contained 100 hives of bees and over, were entirely wiped out of existence, and bee-keepers in Muscatine Co., Iowa, and in the adjoining county of Mercer, in Illinois, sent to Western Kentucky for a supply of bees to get a new start. These bees were not brought until after fruit-bloom. The cause of the great mortality to bees was said to be poisoned honey that had been gathered by them

during the previous summer. In the summer of 1872 we had a good crop of fruit, although there were no bees to fertilize the bloom. I have also a record that shows that it was a good year for nuts, and that walnuts and hickorynuts were plentiful.

I now wish to draw your attention as a fruit-grower to the methods in vogue in securing the proper fertilization of strawberries. No fruit-grower would think of planting a variety of strawberry that was pistillate more than 16 feet from a staminate variety. If he did, he would not expect to secure much of a crop from them for want of proper fertilization. If, as has been so often asserted, the proper fertilization is secured by the honey-bees, then there would be no necessity of this close planting, as the bee usually, in its flight from flower to flower, covers much more than the distance mentioned. I must, however, say that, after close observation in my 20 years' experience as a fruit-grower, I never knew bees to work on strawberry bloom to any extent, and some years they scarcely visit the strawberries at all when in bloom; yet they were properly fertilized, and produced a good crop, showing conclusively that the fertilization of the strawberry takes place without the aid of honey-bees.

As boy and man I have kept bees for over 40 years, and during the first 30 years of my experience I frequently sowed buckwheat, so that my bees would have fall pasture; but I have to record the fact that more than half the time that I raised buckwheat my bees never gathered a pound of buckwheat honey, and yet it never made any difference whether the bees worked on the buckwheat bloom or not. I got a crop of buckwheat all the same. Nature did its own fertilizing. Four years ago one of my neighbors had five acres of buckwheat within half a mile of my apiary of 35 hives of bees, and I watched that buckwheat closely, in hopes of getting a good supply of fall honey; but my bees never visited it, and I got no buckwheat honey; but my neighbor did get a good crop of buckwheaat.

Basswood is one of our best sources of honey, and basswood raises seed just the same as fruit-trees raise fruit, and it is just as necessary that the bloom of basswood and other forest-trees be fertilized to make them bear as it is that fruit-trees should be fertilized for the same purpose. Some seasons I have known basswood-trees to be laden with bloom, and the bees worked on it in swarms from daylight until dark, and the same years the trees would be full of seed, and other years the trees would be loaded with bloom, and not a bee would visit them, and yet the trees would be loaded with seed. The past summer was just such a season with us. Every day during basswood bloom I passed ten or twelve basswood-trees from four to six times in making my trips to market with berries; and although the trees were fairly covered with the large clusters of bloom, a careful watch never showed a single bee on any of the trees, and yet those trees were properly fertilized, as shown by the large crop of seed.

I have been living where I now live, for 22 years, and in my dooryard are several good-sized oak-trees. I have watched those trees when in bloom, and find that some years the bees work on the bloom, and other years they take no noti e of it whatever, and it makes no difference whether the bees work on it or not. The trees raise acorns every year when they bloom. Wheat, oats, and other small grain, produce pollen just the same as fruit and forest trees, and fertilization is just as necessary to them as to fruits; yet the claim is never made that bees are necessary to the fertilization of these crops. The fact is, bees do so little work on them that they are lost sight of in a discussion of this question. It must be admitted, however, that, if nature can properly fertilize these crops without the aid of bees, it can fertilize fruit or any other crop without their aid.

Sometimes the statement is made, that certain kinds of fruit in certain specified localities have failed to produce fruit, and that the introduction of bees into that locality has caused an entire change, the bees being credited with fertilizing the bloom, and thus causing the trees to become fruitful. This claim, in the absence of more pronounced experiments, is not to be relied on. Many orchards have failed to bear fruit for a number of years, and then become fruitful, although bees were plentiful every year. In the spring of 1892 my orchard bloomed profusely, as did all other orchards in Muscatine Co. The spring was rather wet, but yet there were days when the bees worked briskly, and gathered both honey and pollen, and yet we had no fruit. The cause of the failure to bear fruit was not for want of proper fertilization. The present year we had no apples, and other tree-fruits were scarce, and the cause of the failure was not for the want of proper fertilization, but from other causes. We are in hopes of a good crop of fruit next year; and if we get it we shall not give the bees the credit, as they failed to give us a crop the past two years; and should the same or a similar calamity that overtook the bees in 1871 overtake and wipe them out of existence, and should we get a good crop of fruit next summer, we will not blame the bees for our failure the past two years, for we know the causes have been entirely outside of any influence they have had.

There is much more that might be written on this subject; but enough has been given to show that there are two sides to this question, and that the only way to bring out all the facts and arguments bearing on the subject is to have an unbiased and unprejudiced discussion of the same.

I might add, that, after 20 years' study of the

matter, I now believe that nature never intended that vegetable productions, in their love-embrace, should ever require the aid of a third party, any more than the human family or animals, and that nature has furnished every living species or kind the power to reproduce itself within itself. W. S. FULTZ.

Muscatine, Ia.

[This is pretty well answered in an article we published in 1891, Sept. 15, from the pen of Prof. Cook. Our comment appears further on. It is not our custom to reprint old articles; but in this discussion many of our present readers may not be able to refer to the back number mentioned.]

The producers of flower-seeds in our cities keep bees in their greenhouses, as they find this the easiest and cheapest method to secure that more perfect fertilization upon which their profits depend. Secretary Farnsworth, of the Ohio Horticultural Society, could account for a very meager crop of fruit a few years since, in his vicinity, after a profusion of bloom, only through lack of pollenization. The bees had nearly all died off the previous winter. I have often noted the fact, that, if we have rain and cold all during the fruit-bloom, as we did in the spring of 1890, even trees that bloom fully are almost sure to bear as sparingly.

Darwin's researches considered insects as a whole, and it is true that all insects that visit flowers, either for nectar or pollen, do valuable service in this work of pollenization. Thus many of the hymenoptera, diptera, and coleoptera, and not a few lepidoptera, are our ever ready helpers as pollenizers. Yet early in the season, in our northern latitudes, most insects are scarce. The severe winters so thin their numbers that we find barely one, whereas we can find hundreds in late summer and early autumn. In late summer the bumble-bees and paper-making wasps number scores to each colony, while in spring only one fertile female will be found. This is less conspicuously true of solitary insects, like most of our native bees, and wasps; yet even these swarm in late summer, where they were solitary or scattering in the early spring. The honey-bees are a notable exception to this rule. They live over winter, so that even in early spring we may find ten or fifteen thousand in a single colony, in lieu of one solitary female, as seen in the nest of bombus or vespa. By actual count in time of fruit-bloom in May, I have found the bees twenty to one of all other insects upon the flowers; and on cool days, which are very common at this early season, I have known hundreds of bees on the fruit-blossoms, while I could not find a single other insect. Thus we see that the honey-bees are exceedingly important in the economy of vegetable growth and fruitage, especially of all such plants as blossom early in the season. We have all noticed how much more common our flowers are in autumn than in spring time. In spring we hunt for claytonia, the trillium, and the erythronium. In autumn we gather the asters and goldenrods by the armful, and they look up at us from every marsh, fence-corner, and common. In May *our* flowers demand a search, while in California the fields of January and February are one sea of blossoms. The mild California winters do not kill the insects. There a profusion of bloom will receive service from these so-called "marriage-priests," and a profusion of seed *will* greet the coming spring time. Thus our climate acts upon the insects, and the insects upon the flowers, and we understand why our peculiar flora was developed. Yet notwithstanding the admirable demonstrations of the great master Darwin, and the observations and practice of a few of our intelligent practical men, yet the great mass of our farmers are either ignorant or indifferent as to this matter, and so to the important practical considerations which wait upon it. This is very evident, as appears from the fact that many legislators the past winter, when called upon to protect the bees, urged that fruit-growers had interests as well as the bee men, not seeming to know that one of the greatest of these interests rested with the very bees for which protection was asked.

Now that we understand the significance of the law of adaptation in reference to the progressive development of species, we easily understand why our introduced fruits that blossom early would find a lack of the "marriage-priests," and why it would be a matter of necessity to introduce the honey-bee, which, like the fruits, are not indigenous to our country, just as the bumble-bee must go with the red clover, if the latter is to succeed at once in far-off New Zealand.

It is true, that we have native apples, cherries, plums, etc. But these, like the early insects, were scattering, not massed in large orchards, and very likely the fruitage of these, before the introduction of the honey-bee, may have been scant and meager.

Now that spraying our fruit-trees with the arsenites, early in the spring, is known to be so profitable, and is coming and will continue to come more generally into use, and as such spraying is fatal to the bees if performed during the time of bloom, and not only fatal to the imago, but to the brood to which it is fed in the hive, it becomes a question of momentous importance that *all* should know that bees are valuable to the fruit-grower and the apiarist alike, and that the pomologist who poisons the bees is surely killing the goose that laid the golden egg. That bees are easily poisoned by applying spray to trees that bear nectar-secreting blossoms, at the time of bloom, can be easily demonstrated by any one in a very short period of time. It has been demonstrated in a frightfully expensive manner in several apiaries in various parts of the country. Several bee keepers, whose all was invested in bees, have lost all this property, all because some fruit-growing neighbor either thoughtlessly or ignorantly sprayed his fruit-trees while in bloom; and this in the face of the fact that, for the best results, even in the direction sought, the spraying should be deferred until the blossoms fall. I have demonstrated this fact, where the results were entirely in sight. I have shut bees in a cage, and given them sweetened water, containing London purple in the proportion of one pound to 200 gallons of water, and in 24 hours the bees were all dead; while other bees, in precisely similar cages, and fed precisely the same food, with the poison omitted, lived for many days.

We thus see that it becomes very important that pomologist and bee-keeper alike know the danger, and also know the loss to both parties in case caution is not observed to avoid the danger and probable loss. It is also important that, by definite experimentation, we may learn just how important the bees are in the pollenization of plants. To de-

termine this point, I tried many experiments last spring. I counted the blossoms on each of two branches, or plants, of apple, cherry, pear, strawberry, raspberry, and clover. One of these, in case of each fruit or each experiment, was surrounded by cheese-cloth just before the blossoms opened, and kept covered till the blossoms fell off. The apple, pear, and cherry, were covered May 4th, and uncovered May 25th and May 19th. The number of blossoms considered varied from 32, the smallest number, to 300, the largest. The trees were examined June 11th, to see what number of the fruit had set. The per cent of blossoms which developed on the covered trees was a little over 2, while almost 20 per cent of the *uncovered* blossoms had developed. Of the pears, not one of the covered developed, while 5 per cent of the uncovered developed fruit. Of the cherries, 3 per cent only of the covered developed, while 40 per cent of the uncovered blossoms set their fruit. The strawberries were covered May 18th, and uncovered June 16th. The number of blossoms in each experiment varied from 60 in the least to 212 in the greatest. In these cases, a box covered with cheese-cloth surrounded the plants. The plants were examined June 22d. Eleven per cent of the covered blossoms, and 17 per cent of the uncovered had developed. To show the details, in one case 60 blossoms were considered, 9 of which in the covered lot, and 27 in the uncovered, had developed. That is, three times as many flowers had set in the uncovered as in the covered. In another case of 212 blossoms, the fruit numbered 80 and 104. In a case of 123 blossoms, the number of fruit was 20 and 36.

These experiments agree with similar ones of former years, in seeming to show that strawberries are less affected than other fruit by the exclusion of insect visits. The raspberry canes were covered with cheese-cloth May 30, and uncovered July 6. In every case but one the canes seem to have been injured by the covers, and so the results were not considered. In the exceptional case, 184 blossoms were considered; 93 blossoms developed on the covered canes, and 160 on the uncovered. In every case the fruit on the covered twigs was inferior. It might be thought that the simple presence of the covers was prejudicial; though this could not be a very important matter, as blossoms covered after the bees had freely visited them set well, and showed no injury. Thus we see that, in all our fruits—strawberries the least—the free visits of insects during the period of blooming is absolutely essential to a full or even a fair crop. In many cases the covered blossoms all fail to develop. We also see that, where fruitage does occur, there seems a lack, as the fruit lacks vigor. The free and ample *cross-fertilization* seems to be requisite, not only for a crop, but for a perfect development and maximum vigor.

Our experiments with clovers were tried with both the white and alsike. While the uncovered heads were full of seeds, the covered ones were entirely seedless. This fully explains the common experience of farmers with these plants.

Having the law of the necessity of insects to accomplish this function so well demonstrated, it might be asked. "Why do we have *any* fruit in case the blossoms are covered?" This seeming exception may be no exception. Indeed, this may come from the fact that *all* insects are not excluded. Very many insects, like the thrips, and various of the jassidæ, which we know are often attracted to flowers, either by the pollen or nectar, would be concealed about the plants, and, from their small size, might gain access, even after the covers were adjusted. These would be sufficient to secure partial fertilization, and very likely are the cause of the meager crop which, in a few cases, we secure, even on the covered twigs.

In case of strawberries, our experiments this year, like some previously tried, seemed to show that the presence of insects, though important to a maximum production, are not so necessary as in case of nearly all other fruit. But we must remember that the strawberry-plants are not wholly inclosed. A cloth-covered box rests on the ground about the plant. This gives a fine chance for insects that burrow in the earth, and for insects that have pupated in like position to come up during the three or four weeks of the experiment, and pollenize the blossoms. This, though a possible, and (shall I say?) a probable explanation, may not be the real one. But we can still affirm, in case of the strawberry, that the free visits of insects serve surely to much enlarge the production of fruit.

Thus we see that our horticulturists and farmers alike, with the apiarist, are dependent for the best prosperity on the presence and well-being of the bees. They should realize this fact, and should demand that our legislators not only become informed, but act accordingly.

[In the *American Bee Journal* for Dec. 14 appears a letter from G. W. Brodbeck, of Los Angeles, Cal., one of the leading bee-keepers of the State. We have room for only two paragraphs of his valuable article, and here they are:]

The California State Fruit-growers' Association has been in session here this week; and, being interested to some extent in fruit culture, as well as bee culture, together with Mr. McIntyre (who was a delegate), we heard much of interest to fruit-growers, and, at its close, something that caused us bee-keepers to prick up our ears and listen with close attention.

The subject was "Fertilization." A gentleman stated that he had a friend in this State who started into fruit-growing several years ago, locating 35 miles from any fruit-growing section, or where any bees were located. The first year that his trees blossomed, and in expectancy of at least some returns from his orchard, what should be the result but complete failure! He was advised to procure some bees to aid in the fertilization of the blossoms, and since then his orchard has been productive.

[Again, in the *American Bee Journal* for Jan 4 appear also two paragraphs from the pen of C. J. Berry. He is Horticultural Commissioner for Tulare Co., an inland county that has of late made great progress in the fruit-industry. Mr. Berry, whose orchard contains 440 acres, writes:

Bees and fruit go together. I can't raise fruit without bees. Some of the other cranks say I'm a crank; but I notice there is a pretty good following after me, hereabouts, and they keep a-comin'.

Yes, sir, 'e. I have bees all about my big orchard. *Two years in succession I have put netting over some limbs of trees; and, while they blossomed all right,*

ary fruit; while on the same tree, where limbs were exposed to the aid of bees, plenty of fruit.

Italics are ours. Such statements, coming from the fruit-men, are certainly strong evidence in favor of the bee. We may think that the statements from the bee-keepers would be biased; but when the *fruit-men* turn around and defend the bee, as they surely have done, will do, and are doing, the old-time opposition will gradually break down.

This symposium would be incomplete did we fail to make mention of the fact that, some three or four years ago, in the State of Michigan a convention of fruit and bee men assembled together for the purpose of discussing their *common* interests. The fruit-men acknowledged generally that the keeping of bees in the vicinity of their orchards was an important factor in the production of fruit. At various conventions of the Michigan State Bee-keepers' Association there has been furnished abundance of evidence, from bee-keepers and fruit-growers, that points in the same direction. Indeed, fruit-growers often become bee-keepers —not from the honey the bees may furnish them, but because they have found it necessary to keep bees in order to secure the perfection of fruit.

You will see that we are disposed to be fair in the matter, because we have given "both sides." But we are not at all afraid but that, when all the evidence is weighed, the balance of testimony on the bee side will completely overbalance the testimony on the other side.

The statement in the *Rural* (see Dr. Miller's article), that fruit has grown where no bees were known, proves nothing. Potatoes, wheat, and all other crops, will grow on poor land; but it would be foolish to say that there would not be *larger* crops on good land, or under other conditions more favorable. It is equally foolish to assert that, because fruit has been grown remote from bees, the importation of bees into that vicinity would have no effect. Again, the point is made by friend Fultz, that nuts and some other kinds of fruits, etc., were known to grow without the fertilization of any bees. Bee-keepers do not claim—indeed, it would be foolish to do so—that *all* products whatsoever depend for their fertilization upon the agency of the bees. All we claim is, that a large number of fruits are *assisted*, both in the quality and quantity of fruit.

[*The following appeared in Feb. 15th issue.*]

BEES NOT NECESSARY TO THE PROPER FERTILIZATION OF FRUIT-BLOOM.

By W. S. Fultz.

In studying this question I have tried to do so in an unprejudiced manner, being both a bee-keeper and fruit-grower. I have looked at it from both standpoints. Why all bee-keepers, in trying to discuss this question, always merge it into that of spraying and the destruction of fruit by bees, is more than I can understand. There seems to be such a strong undercurrent of feeling among them all in that direction, it naturally leads the public to believe that they have an ax to grind, and that they seek every opportunity to get it on the grindstone.

As a fruit-grower I have my own ideas of those other questions; and my experience of 20 years in the business, with an apiary on the same farm, has enabled me to decide those questions to my own satisfaction; but I do not think they have any bearing on the subject under discussion, and shall ignore them entirely. With me, in discussing this question, there is no "negro in the woodpile."

I now wish to draw attention to your editorial on page 61, in which you say that my arguments are based largely on negative testiomony, and that Prof. Cook and the rest rely upon positive facts and figures. In my article I gave several instances where I had observed good crops raised without the aid of bees. If that is not positive evidence that crops can be so raised, then I must plead being ignorant as to what positive evidence is.

[Your evidence on this point is negative, because you produce no proof that the crop in question would not have been better by having bees. If for ten years *without* the bees your crops were good, and for ten years *with* the bees the crops were smaller and poorer, you would have evidence of positive character against the bee.—ED.]

With regard to the experiments of Prof. Cook, Mr. Gilliland, and the others to whom you refer, I must say that, in my opinion, all such evidence is negative, or, rather, it is no evidence at all. When Prof. Cook and the others placed cheese-cloth or netting over the bloom with which they were experimenting they interfered with nature's methods of fertilization. I would almost as soon shut up a female hog in a latticed pen, where she would be kept entirely from all contact with her kind, and expect her to be fruitful and multiply, as to expect a fruit-bloom to become fertilized under the same conditions. Nature intended that a contact should take place to make that bloom fruitful; and Prof. Cook, and the others to whom you refer, covered those flowers and shut off nature's methods, and then asserted that, because the bees could not get to the flowers to fertilize then, they proved barren or nearly so. Had those flowers that were experimented with not been covered, so that nature could have performed her functions, it is safe to say that they would have been properly fertilized, even if no honey-bee had ever been near them.

[Your illustration of the hog in the pen is not a parallel case. Most fruit-blossoms will fertilize themselves to a large extent, but there is no self-fertilization in the animal kingdom.—ED.]

Some other means must be resorted to, when making those experiments, than covering the bloom, otherwise all results will be negative. Any well-posted horticulturist could have told Prof. Cook what the probable results would be, at the commencement of his experiments, for

they were just what might have been expected. The bloom operated upon was probably staminate, and produced pollen, and, as a natural consequence, became self-fertilized, and the result was an inferior product. I do not care to follow or analyze the article of Prof. Cook; his arguments and conclusions are all based on the same kind of experiments, and, as a consequence, are all of a negative nature, and of no force whatever.

Now, Mr. Editor, let us get at the gist of this question. In the article sent you by Mr. Doolittle, I simply made the assertion that the aid of honey-bees was not needed in the proper fertilization of fruit-bloom. Now I am going to make the broader assertion, that fertilization is not aided to any extent by them. This assertion is based on the fact that no horticulturist, however expert he may be in the art of artificial fertilization, can take the pollen from a honey-bee, and, without changing its condition, successfully fertilize a fruit-blossom. If an expert horticulturist can not do this, then how can a bee do it? The horticulturist's object is to fertilize; the bee's object is to gather the pollen and honey, and carry it to the hive. The instinct of the bee does not teach it how to prepare pollen for fertilization purposes. Man's knowledge and ingenuity do, and man can take the pollen from a bee, and, after properly preparing it, make it successful in fertilizing.

It would be an easy matter to test this thing. Let three or more persons in widely separated localities cover at least 100 fruit-blossoms (apple being the most plentiful would be preferred), in the same manner as was done by Prof. Cook and others. This should be done before the flowers were fully opened; then when they are open take a small pair of scissors and remove the stamens, so that self-fertilization can not take place, replacing the covers immediately, and let them remain until the pistil of the flowers are in a receptive condition, and then take pollen from honey-bees that are gathering it from the same kind of trees, and try to fertilize the covered bloom with it, just as it is taken from the bees. If such experiments are successful, then bees can assist in fertilizing fruit-bloom; but if they are a failure, as I am well satisfied they will be, then the claim that they do assist is not well founded, and should be dropped by the bee-keeping fraternity.

Wet or even damp pollen, as has been demonstrated by experiment, is not potent, and will not perform its intended function. This accounts for the fact that, when we have wet weather during fruit-bloom, we get no crop. The pistil of the flowers pass beyond their receptive state during the time that the pollen remains impotent; consequently no fertilization can take place that season.

Muscatine, Ia., Jan. 22.

[In view of the *bulk* of the testimony to the contrary appearing in this number, it is rather a strong statement to say that "fertilization is not to any extent aided" by the bees. As to the other points in your article, honest investigation courts fair criticism.—ED.]

BEES AND FRUIT ON THE ISLANDS OF LAKE ERIE.

By Thaddeus Smith.

We ought to be able to get a satisfactory answer to this question by bringing together the facts about it, and looking at these facts with an unprejudiced mind, not committed to any particular theory, and not biased by self-interest. I have been a bee-keeper for over forty years, and I am also a fruit-grower, and I think I can look at both sides of the question in an impartial manner. I will say here, that I have changed my views about this matter, as I have done with some other cherished views of bee culture that I was taught and have taught others.

I live upon an island; and when I came here 25 years ago there were but two colonies of bees here. These I bought and immediately Italianized, and engaged in raising queens, as there were no black bees here to mix with them. The fruit here 25 years ago was more certain, and less affected by disease, than it has been for several years just past. The bees have increased to 100 or more colonies, and have been distributed to various parts of the island. Shall I say the increase of bees is the cause of the decrease of quantity and quality of fruit? No, far from it. But such is the kind of argument used by some on the affirmative of this question.

Not very long ago I read a communication to one of our bee-papers, stating that the writer had put some stands of bees in *one corner* of his garden, or yard, and that the fruit-trees in that part of the garden had given a good crop of fruit, while the trees in the other corner of the garden had failed in fruit. This statement was given to show what a great advantage bees were in fertilizing bloom. Will any intelligent bee-keeper accept this experiment as a knock-down argument?

I have never met Prof. Cook; but from his writings and character I have learned to esteem him very highly. In fact, I have been almost ready, as the saying is, to swear by any thing that Prof. Cook would say. But in the article republished in GLEANINGS he has certainly deduced some unwarrantable conclusions from some facts stated. For instance, he says: "I have often noticed the fact, that, if we have rain and cold all during the fruit-bloom, even trees that bloom fully are almost sure to bear sparingly." This is accounted for by Prof. Cook, solely because it was too cold for the bees to fly. But is there not a much better reason to account for this failure to fruit? Every fruit-grower knows that these cold rains fill

the bloom with water, and sometimes ice, and is as destructive to the embryo fruit as a heavy frost. This damp cold weather would also prevent pollen from being carried about by the wind. Again, Prof. C. covered some fruit-blooms with *cheese-cloth*, and the result was they were not fertilized as well as those left uncovered. Any one would have naturally expected this, as this cheese-cloth would certainly keep off the pollen floated about by the wind. Did he or any one else see the bees visit those uncovered blossoms? If not, why make such a positive statement that the bees were the sole cause of their fertilization?

But it is not my intention to criticise the articles in GLEANINGS, but to give some facts bearing upon the subject. Within ten miles of me there is a tight little island in Lake Erie where no bees are kept; and it is so far from main land, and other places where bees are kept, that bees never visit it. This island is almost entirely used for fruit-growing, and a success is made of it. But the editor of GLEANINGS says, "That fruit has grown where no bees were known, *proves nothing*." Let's see. I have a friend on this same island devoted to growing fine fruit; and his fruit, whether of apples, pears, plums, or cherries, or his especial pride, strawberries and raspberries, can not be grown to any greater perfection upon any land of the same quality in the State of Ohio, though there were 100 stands of bees in the "corner of the garden." But this may "prove nothing," except the old adage,

> Convince a man against his will,
> He's of the same opinion still.

It may be said that, in the absence of bees, other insects may have fertilized the fruit-bloom. Well, if other insects fertilize the bloom so perfectly, why say that *bees are necessary* to do it? But Prof. Cook shows the improbability of the other insect theory. He says, in the same article quoted before, "Early in the season in our northern latitude most insects are scarce. The severe winters so thin their numbers that we find barely one; whereas we can find hundreds in late summer," etc., showing conclusively that the fine fruit of this place was not owing to insect fertilization.

And now for the "bumble-bee." Every one will admit that it is a *hum*-bug; and I think this red-clover-seed theory connected with it is the biggest kind of a humbug. There are but few bumble-bees on this island, some seasons scarcely any. For every single bumble-bee here, I believe there are ten thousand, and, I might safely say, ten million clover-heads. In a favorable season, red clover makes a fine yield of seed here. It would simply be impossible for the bumble-bees to visit all the heads containing seed.

Pelee Island, Ont.

[Perhaps some unwarranted conclusions have been drawn by both sides; if so, let's have the fallacies shown up. While you are peculiarly well situated for getting facts, some of *your* conclusions will not stand the closest scrutiny. For instance, you say you have a friend, a fruit-grower, on an island where no bees exist, whose fruit "can not be grown to any greater perfection upon any land of the same quality," where there are 100 stands of bees. We ask, how do you *know* this? and what do you mean by perfection? The fruit may be "perfection" in your estimation, but how do you know that it would not be better if bees were present at blossom time? We insist, again, that it does not prove much to assert that a friend of yours grows the "perfection of fruit" on an island remote from bees. If he had grown fruit for ten years *without* bees and then ten years *with* the bees, there would then be an opportunity for a *fairer* comparison. Again, in your last paragraph you say nothing about the possibilities of the Italians fertilizing the red clover. The probabilities are, that the ordinary hive-bees do ten times more pollen-scattering on these big clovers, because of their numbers, than the bumble-bees. Here, again, if all bees were removed, both bumble-bees and hive-bees, for a few seasons, from access to red clover, and then again for a few seasons allowed to visit the blossoms, the test would be fairer; and then, how do you know that the bumble-bees do not do their share? As we see it, friend Smith, you have unconsciously fallen into the same error in drawing conclusions that you find in the writings of those who affirm that bees do assist in scattering pollen.—ED.]

THE ELEMENTS OF UNCERTAINTY IN THE RECENT DISCUSSION.

By John C. Gilliland.

There are some well-known facts to be taken into consideration in the discussion of animal life aiding in the fertilization of blossoms and plants. We know, both by revelation and geology, that plants were created before animal life, and had power within themselves to perfect seed, and in their natural forms do so yet. While all forms of plants and animal life are more or less dependent on each other, the lower forms are more independent than the higher. Commencing with the lowest, each new creation was for and looking to a higher order, and all orders of animal life are dependent on plants for continued existence. All orders, whether of plants or animal life, were good, and for a good purpose at first; and the evil and conflict we see is only perverted good. There is nothing evil of itself, as all evil is only perverted good. By the power of his intelligence and selection, man has changed the form and use of many kinds of both plants and animals; and who shall say that the lower forms of animal life have not done the same? But the real question is, How much increase is there in

seed production of plants by insect aid? Are not plants entirely dependent on insect aid for seed production? All progress made is only filling the duty to "go forth and multiply and replenish the earth, and subdue it." By observation and experiment we find what orders of plants and animals are useful, or can be so changed as to be useful, and what order will aid us in making the change, and then aid the development of the useful. Also, find the orders injurious, and destroy them. If we could get all the people in the world to see and think, the progress in subduing the earth would be as great in five or ten years as in all the ages past by the few great minds who have thought and seen things as they are and might be.

There are several elements of uncertainty in the facts stated on both sides in Jan. 15th GLEANINGS. Where fruit and seed do not develop when cold and rain prevent insect visits when blossoms are open, the same causes prevent the normal development of pollen, and, by washing off what is developed, prevent it from fertilizing the blossoms. When a single blossom is covered to keep off insects, it also, to a certain extent, prevents the wind from carrying the pollen of other blossoms to it to aid in its fertilization. A single blossom covered may not fertilize itself; but if a whole tree were covered, enough blossoms might be fertilized to yield a crop of fruit. I saw this chance for error last year in my experiments, and for this reason intend to cover all the plants on three or four feet square by driving stakes and covering with netting, then gather the ripe seed each ten days, also ripe seed on a like space by the side of the covered, and find the seed in each lot at each gathering. This will take out nearly all the elements of uncertainty, and tell whether the time of blooming or temperature has an effect on seed production.

I suggest the bee-keepers make experiments on this question this year on different fruit-trees and other plants, not covering a single blossom by itself, but have a large number under the cover, carefully taking notes of weather, rain, cold, and whether bees worked freely on uncovered blossoms; then how much fruit or seeds produced from same number of blossoms under each condition, leaving nothing to guess at or state from memory. I should especially like to have E. R. Root, G. M. Doolittle, C. C. Miller, and Prof. Cook make the experiment; then if A. I. Root will hold off publication of that leaflet until fall we may have some very interesting reading for the public. Cheese-cloth is very cheap, and it will not cost much to cover a whole tree.

Bloomfield, Ind., Jan. 20.

[Covering certain blossoms and not others may bring in some elements of uncertainty, as you say; but the fact that all the experiments made by Prof. Cook and others point pretty strongly toward the agency of the bees, is pretty good proof. However, we are sure all candid bee-keepers want to go to the bottom of things; and we hope that, ere another year, the experiment will be tried by several in the way you indicate. We will publish the pamphlet now, and by fall may get out another. The information already secured is too good to hold. If the covering of individual blossoms to some seems objectionable, perhaps the following will answer.—ED.:]

THE TWO SIDES OF A TREE.

Our apple-orchard is situated in such a way that it is exposed to both the north and south winds. About four years ago, as the trees on the south row (Transcendenteral, that throws out a heavy growth of foliage at the same time it blooms) began to open its bloom, a heavy south wind prevailed for about five days. I noticed, during this period, that the bees could not touch the bloom on the south side of these trees, but worked merrily on the more sheltered limbs of the north side. What was the result? Those limbs on the north side were well loaded with fruit, while on the south side there was almost none to be seen. Does this prove that these trees depend on the aid of insects to fertilize the bloom? I leave it to the judgment of the reader. F. M. MERRITT.

Andrew, Ia., Jan. 19.

TESTIMONY FROM A FRUIT-GROWER.

Mr. Root:—Find inclosed an article on "Bees for Fruit-growers," written by the editor, Chas. A. Green, and clipped from *Green's Fruit-grower*, published at Rochester, N. Y. Mr. Green is quite a distinguished and well-known fruit-grower of Western New York, and is eminently qualified to judge on the fertilization of fruit-blossoms by the bees. F. H. FARGO.

Batavia, N. Y., Jan. 25.

Is the honey-bee beneficial or detrimental to fruit-growers? This has been an open question for many years. It has been contended by some, erroneously, that bees puncture grapes, peaches, and other fruit when ripe, greatly to the injury of the fruit. At the same time, it has been noticed that bees frequent the berry-fields and the orchards in great numbers during the blossoming season. It was granted that, in a few cases, bees might be beneficial in fertilizing the blossoms, more particularly of the strawberry, which was known to be often pistillate.

It has now become demonstrated that many kinds of fruits, if not all kinds, are greatly benefited by the bees, and that a large portion of our fruit, such as the apple, pear, and particularly the plum, would be barren were it not for the helpful work of the honey-bee. This discovery is largely owing to Prof. Waite, of the Agricultural Department at Washington. Prof. Waite covered the blossoms of pears, apples, and plums, with netting, excluding the bees, and found that such protected blossoms of many varieties of apple and pear yielded no fruit. In some varieties there was no exception to the rule, and he was convinced that large orchards of Bartlett pears, planted distant from other varieties,

would be utterly barren were it not for the work of the bees, and even then they could not be profitably grown unless every third or fourth row in the orchard was planted to Clapp's Favorite, or some other variety that was capable of fertilizing the blossoms of the Bartlett.

In other words, he found that the Bartlett pear could no more fertilize its own blossoms than the Crescent strawberry. We have already learned that certain kinds of plums will not fertilize their own blossoms, such as the Wild Goose, etc.

The fruit-growers of the country are greatly indebted to Prof. Waite for the discovery he has made. The lesson is, that fruit-growers must become interested in bees, *and I do not doubt that within a few years it will be a rare thing to find a fruit-grower who does not keep honey-bees*, the prime object being to employ the bees in carrying pollen from one blossom to another from the fields of small fruits as well as for the large fruits.

Think of the changes that have occurred in the last twenty years. In olden times there were as many bees as there are now, and there were not a thousandth part as many orchards or berry-fields as now. Therefore, if the honey-bee has to visit the blossoms as in olden times it will have to visit one thousand, where in olden times they had to visit only one blossom. I verily believe that the barrenness of many orchards may be owing to the scarcity of bees.

During some seasons, the scarcity of bees may be less noticed than other seasons. If the season is a dry one during the blossoming time, many blossoms are fertilized by the winds and other insects than the honey-bee; but if the season is wet, and prolonged rains occur, the honey-bee has no power to fulfill its helpful mission.

This is a question that should receive the attention of every fruit-grower. The honey-bee is useful and profitable by itself alone. C. A. GREEN.

BEES AND FLOWERS.

By G. M. Doolittle.

It was with more than usual interest that I read the different views relative to the aid bees render in the matter of fertilizing flowers of various kinds, in the last number of GLEANINGS; but what interested me still more was the fact that friends Root proposed to put the pros and cons of the whole matter in pamphlet form for general distribution. This is something we have needed for a long time, and, if I am not greatly mistaken, the doing of this will have a greater influence toward dispelling the mist which has gathered before the eyes of the farmer and horticulturist — gathered more largely through jealousy than otherwise, than any thing heretofore done. I said *jealousy* had been largely the cause of this mist gathering before the eyes of the horticulturist and farmer. I think I hear some one ask why these should be jealous. Only from that innate weakness, common to all, that causes a restlessness to come over us at seeing others more prosperous than we are. No sooner did it go out that Doolittle was making money out of bees than a few about me began looking around; and when they saw bees at work on the bloom in their orchards, meadows, and buckwheat-fields, they began to reason that Doolittle was getting rich from that which belonged to them, and from this sprang the thought that the saccharine matter found in the flowers was placed there for the development of the fruit; and as the bees took away this sweet as fast as it was secreted by the flowers, an injury must result to the product coming from these flowers and their fields, which injury did much to enhance Doolittle's gains.

Since going into the queen business I have heard less of this than formerly; but from my own experience I doubt not that every prosperous bee-keeper has either heard something similar to this, or, if he has not heard it, his neighbors have talked it when not heard by him. I have even been asked for ten pounds of nice comb honey as pay for what honey the bees gathered from a ten-acre lot of Canada thistles which the owner of the land had allowed to grow up through his shiftlessness.

Such a pamphlet as the one proposed will do away with all this way of thinking, if placed in the hands of those about us before they begin to be jealous; and instead of their thinking that we are getting rich off their broad acres they will welcome the bee-keepers of the land as a blessing in helping them to secure good crops of fruit and grain.

It will be remembered that I have taken a little different view of the matter than most of the writers on this subject; and as I believe this view is the right one, I wish to say a few words further by way of emphasis in the matter. The view I hold to, and, as I believe, the only *right* view, is, that the first object of honey in the flowers was *not* as a food or luxury for man, nor even to sustain the life of the bees, but as a means to an end, and that end was, that the fruit, or female blossoms of plants, which could not be possibly fertilized in any other way, might be fertilized through the agency of insects which would be attracted to these flowers by the tempting and attractive morsels of sweet they spread out before them as a sumptuous feast, while honey as food for the bee and for the use of man came in as a secondary item. As Gregory puts it in his treatise on squashes, "The *primary* reason why a squash grows, is, to protect and afford nutriment to the seed—the use of it as food being a secondary matter," and the same reason holds good when we look into this honey matter. Why is honey placed in the flowers? To attract insects that the blossoms may be properly fertilized, *primarily;* and, secondly, for food for these insects, which food for insects, in case of the bee, is utilized by man.

Why I come to quote Gregory, as above, was because I knew he said something that was favorable toward the bee side of this fertilizing matter; and in looking it up I ran across the

sentence quoted above. As Gregory is not a bee-keeper, what he says can be taken as an unbiased decision. Here is what he says for the bee along this line: "The female blossoms of the squash are so covered and hidden by the tall leaves, that it is evident that the fertilizing pollen must be conveyed to them by the bees, to whom the squash-field appears to be a rich harvest-field. All of the crossing or mixing of squashes is caused by the pollen from the male flowers of one variety being carried by the bees to the female flowers of another variety." He further states, that, if the bees are kept from these female blossoms by means of netting or otherwise, the embryo squash, at their base, will always turn yellow and die, unless pollen is carried by man from the male to the female blossoms, as is done in the hybridizing of squashes to produce different varieties. Here is something for Mr. Fultz and the doubting ones to disprove before they can establish the merits of their side of the matter, for I aver that, if honey is placed in any one flower to attract insects so that seed can be perfected, and if no seed can be perfected without these insects, in that variety of flower, then honey was placed in all flowers which secrete nectar, for the sole purpose of attracting insects as aids in their fertilization, and that fruitage to its highest perfection can not be obtained except by the aid of these insects which are attracted by this nectar. I also aver, that, if the above is true, and I can see no logical reason why it is not, then all plants and trees whose blossoms do not secrete honey are capable of self-fertilization through the agency of the breeze or otherwise; hence the taking of all classes of plants and nut-bearing trees to sustain an opposite theory is fallacious, and not worthy of the best efforts of any person. As a matter of history that should go into the pamphlet to make it complete, I would cite the case of bees being banished, years ago, by statute, from the town of Wenham, Mass., on account of their supposed injury to the apple crop of that town. While so banished, the interior orchards of the town gave scarcely any fruit, the little given being very imperfect; while all around the borders, where bees were kept, the fruit set and perfected in the usual style. After a few years of such conclusive proof as this, that the bees were the orchardists' best friend, the law was stricken from the statute, and the bees invited back, to the perfect satisfaction of all concerned.

Again, I wish to note, as a matter of history, that, during the past season of 1893, very little buckwheat honey was secured from the buckwheat regions of the State of New York—so little that we have had, for the first time in my remembrance, buckwheat honey selling in our markets for nearly if not quite the same price as No. 1 clover honey, while it usually sells for about two-thirds the price of clover honey. And what has been the result? Why, the unheard-of thing of buckwheat grain bringing 75 cts. a bushel, on account of its scarcity, while the best of white wheat is selling at only 62 cts. per bushel. As a general thing, buckwheat brings from one-half to two-thirds the price of wheat. That it now brings nearly one-fourth more than the best of wheat tells very largely, under the circumstances, on the side of the bee.

Borodino, N. Y., Jan. 22.

[The following is an extract from a recent government bulletin entitled *Insect Life*, page 254.—ED.]

BEES OF GREAT VALUE TO FRUIT AND SEED GROWERS.

By Frank Benton.

At last fruit-growers and bee-keepers are getting into right relations with each other. The numerous discussions which have taken place regarding the value of bees as fertilizers of fruit-blossoms, and of those blossoms of plants grown for their seeds, and regarding the alleged damage to fruit by bees, have led to close observation and careful experimentation, the results of which show that the interests of these two classes of producers conflict in but trifling respects—that, in fact, bee-keepers and fruit-growers are of great help to each other, and indispensable if each is to obtain the best results in his work.

Bee-keepers have never complained but that the growing of fruit in the vicinity of their apiaries was a great benefit to their interests, hence their position has been merely a defensive one, the battle waxing warm only when poisonous substances were set out to kill off the bees, or when fruit-growers sprayed their orchards with poisonous insecticides during the time the trees were in blossom; or, again, when efforts were made to secure by legislation the removal of bees from a certain locality as nuisances. Fruit-growers first relented when close observation and experiment showed that wasps bite open tender fruits; that birds peck them; that they crack under the action of sun and rains, and hail sometimes cuts them, the bees coming in only to save the wasting juices of the injured fruit. The wide publicity given to the results of the experiments made under the direction of the United States entomologist, and published in the report of the Commissioner of Agriculture for 1885, have no doubt contributed much to secure this change among fruit-growers.

But now it would appear that the bees have not only been vindicated, but that, in the future, fruit-growers are likely to be generally regarded as more indebted to bee-keepers than the latter are to the fruit-growers, for the amount of honey the bees secure from fruit-blossoms comes far short of equaling in value that part of the fruit crop which many accurate observations and experiments indicate is due to the complete cross-fertilization of the blossoms by bees The observations and researches of Hildebrand, Müller, Delpino, Darwin, and others, as well as the excellent explanation of the subject in Cheshire's recent work,* have gone far to prove how greatly blossoms depend upon the agency of bees for their fertilization and hence for the production of seeds and fruits.

The facts they have brought forward are gradual-

* "Bees and Bee-keeping, Scientific and Practical," by Frank R. Cheshire, F. L. S., F. R. M. S., Vol. I., pp. 279-328.

ly becoming more widely known among fruit-growers and bee-keepers, and additional evidence accumulates. A case illustrating very clearly the value of bees in an orchard has recently come to the notice of the writer, and its authenticity is confirmed by correspondence with the parties named, who are gentlemen of long and extensive experience in fruit-growing, recognized in their locality as being authorities, particularly in regard to cherry culture. The facts are these: For several years the cherry crop of Vaca Valley, in Solano Co., Cal., has not been good, although it was formerly quite sure. The partial or complete failures have been attributed to north winds, chilling rains, and similar climatic conditions; but in the minds of Messrs. Bassford, of Cherry Glen, these causes did not sufficiently account for all the cases of failure.

These gentlemen recollected that formerly, when the cherry crops were good, wild bees were very plentiful in the valley, and hence thought perhaps the lack of fruit since most of the bees had disappeared might be due to imperfect distribution of the pollen of the blossoms. To test the matter they placed, therefore, several hives of bees in their orchard in 1890. The result was striking, for the Bassford orchard bore a good crop of cherries, while other growers in the valley who had no bees found their crops entire or partial failures. This year (1891) Messrs. Bassford had some sixty-five hives of bees in their orchard, and Mr. H. A. Bassford writes to the Entomologist: "Our crop was good this season, and we attribute it to the bees." And he adds further:

> Since we have been keeping bees our cherry crop has been much larger than formerly, while those orchards nearest us, five miles from here, where no bees are kept, have produced but light crops.

The *Vacaville Enterprise* said last spring, when referring to the result of the experiment for 1890:

> Other orchardists are watching this enterprise with great interest, and may conclude that, to succeed in cherry culture, a bee-hive and a cherry-orchard must be planted side by side.

And now that the result for 1891 is known, "others," so Mr. Bassford writes, "who have cherry-orchards in the valley are procuring bees to effect the fertilization of the blossoms."

HOW BLOSSOMS ARE FERTILIZED; WHY SOME FLOWERS ARE MORE GAUDY THAN OTHERS; EXPERIMENTS OF CHARLES DARWIN.

By J. E. Crane.

Many volumes have been published in several different languages upon the fertilization of flowers—the first by Christian Conrad Springel, in 1793; but the subject attracted but little attention until thirty or forty years later, since which many botanists have given the subject much attention. Our most eminent botanists now classify flowering plants in their relation to fertilization into two classes: *Anemophilous* and *Entomophilous*—literally, wind-lovers and insect-lovers. The flowers fertilized by the wind are dull in color, and nearly destitute of odor or honey. The sexes are frequently separated, either on the same or on separate plants. They produce a superabundance of pollen, light and dry, easily transported by the air or wind.

Pines, firs, and other conifera, are familiar examples, which sometimes fill a forest with "showers of sulphur" when shedding their pollen. Our nut-bearing trees are examples among decidious trees. The grasses and grains are familiar to all. A kernel of corn will grow as well alone as with other plants; but "the ear will not fill" unless it can receive the wind-wafted pollen from neighboring plants. On the other hand, those plants which seem to have need of bees or other insects to carry their pollen from one flower to another have more showy blossoms, with bright colors, or white, which are showy at dusk, or they give out a strong perfume or nectar, or both. The pollen grains are moist or glutinous, or hairy, or otherwise so constructed as to adhere to the insects that visit them, and thus be carried from flower to flower. In this class of plants or flowers many ingenious arrangements are provided to secure cross-fertilization. One sex is found in one blossom, and the other in another, on the same plant, as in the squash and melon families. In other species the sexes are found upon separate plants, as the willow-trees. In some plants the pistils appear first, and become fertile before the stamens ripen their pollen. In others the stamens shed their vitalizing dust before the stigma of the pistil is ready to receive it.

The common red raspberry matures its pistils first, so that, unless the bees or other insects carry the pollen to it from other earlier blossoms, the fruit is imperfect.

The partridge-berry is very interesting. The blossoms upon about half of the plants produce their stamens first; the other half, the pistil. In a week or ten days the order is reversed in the same flowers.

Many flowers that invite insects appear to be capable of self-fertilization, and often are; but the pollen from some neighboring plant of the same species seems more potent. Some flowers are so constructed that the stamens are placed so that their pollen can not fall upon the stigma of the same flower, but with special adaptation for the transport of pollen by insects from one flower to another. One curious plant produces small inconspicuous flowers early in the season, capable of self-fertilization; later in the season it produces more showy flowers that can become fertile only through the agency of insects.

Many plants remain constantly barren unless they receive the visits of insects. Many of your readers have doubtless observed how the fuchsia or begonia never produces seed in a closed room; yet, when set out of doors in summer, they seed abundantly. Still other plants never produce seed because the insects that feed upon their blossoms have not been imported with the plants.

But this is a large subject, and to me one of great interest, as I study the many ways the Author of nature has provided for the best

good of all his works. A large number of examples have been given of the value of bees as agents in the production of fruit and seed, but I will give one or two more.

Mr. H. A. March, of Puget Sound, while here last summer, informed me that he produced large quantities of California seed, and found bees very valuable, as the seed was much more abundant when bees were provided to work on the flowers.

The stone fruits seem almost incapable of self-fertilization, as is often proved by trying to grow peaches under glass, success seeming to come only when bees are provided when the trees are in bloom.

A curious problem has presented itself to the horticulturists of this country for a number of years past, in the refusal of some varieties of the chicka plum to produce fruit in the Northern States unless set near some other variety or species of plum, that insects might carry the pollen from one to the other. Such a tree I can see from my window as I write, that is a bank of bloom every spring, but has never, to my knowledge, produced a crop of fruit.

Now, suppose it were true that all trees or plants that produce fruit or seed of value for the use of man would become fertile without the aid of bees or other insects, would it prove them of no value? Not at all. Enough has been written to show that the Creator has desired cross-fertilization among plants, and has wisely provided for it in a multitude of ways; and the chances of such fertilization appear to be as great among plants as among our bees, for which such special arrangement has been made. We might assume it to be valuable or necessary, even if we could see no good reason for it. We all know that birds or domestic animals will prove fruitful for one or perhaps several generations in spite of the intermarriage of near relations; but it is, I believe, the universal experience that such unions are most unwise, and, as a rule, prove injurious.

Some twenty-five or thirty years ago Charles Darwin, in studying this subject, and noting the provisions of nature for the cross-fertilization of flowers, became so much interested in it that he began a large number of experiments to test the value of insects in cross-fertilization, and the effects of cross and self fertilization upon plants. His experiments were conducted with great care and continued through several years; and his book on the effects of "Cross and Self Fertilization," describing these experiments, containing several hundred pages, is very interesting reading to say the least.

Of some 125 plants experimented with, more than half were, when insects were excluded, either quite sterile or produced less than half as much seed as when insects were allowed to visit them. Among his catalogue of these plants I notice the white and red clover. His experiments with these are very similar to those of Prof. Cook, late of Michigan Agricultural College. He says, page 361, of red clover, "One hundred flower-heads on a plant protected by a net did not produce a single seed, while 100 heads on plants growing outside, which were visited by bees, yielded 68 grains of weight of seeds; and as 80 seeds weighed two grains, the hundred heads must have yielded 2720 seeds. His experience with white clover was nearly the same.

Another most interesting result of his experiments was that plants grown from seed from self-fertilized flowers were, as a rule, when grown side by side with seed from cross-fertilized flowers, much less vigorous, although in other respects the conditions were as nearly alike as it was possible to make them. On page 371 he says, "The simple fact of the necessity in many cases of extraneous aid for the transport of the pollen, and the many contrivances for this purpose, render it highly probable that some great benefit is thus gained; and this conclusion has now been firmly established by the superior growth, vigor, and fertility of plants of crossed parentage over those of self-fertilized parentage."

Middlebury, Vt., Feb. 8.

STRONG EVIDENCE FROM CANADA, ON BEES AS FERTILIZERS.

By Allen Pringle.

It would seem that there are two sides (and sometimes more) to every question outside of mathematics. Until I read the pros and cons on the above subject in the last issue of GLEANINGS I had supposed that this matter was settled, and fairly within the category of what is called "exact science." While my own opinion on the subject remains unchanged, I realize the fact that others have contrary opinions; and, hence, line upon line, fact upon fact, and argument upon argument, may be necessary to establish what is already established. The subject is one of practical importance to bee-keepers, and this is sufficient justification for the space given and the invitation to discuss. As is often the case in such controversies, both sides are right and both wrong—that is, partially so. It is more than probable that the bee-keepers have been claiming too much for the bees in the fertilization of fruit-bloom; and now "the party of the other part" is going too far the other way, and denying them any credit or function in the matter at all. When the bees were attacked by the fruit-men as the enemies of ripe fruit, and all sorts of charges made against them, the bee-keepers felt called upon to defend their pets, and in so doing discovered that there could be no fruit raised without bees, and told the fruit-men so, and the whole world also. This was a mistake. Fruit may be raised without the aid of the honey-bee. There are other means of fertilization and cross-fertilization—other winged insects—the wings of the wind,

etc. But for certain fruits and clovers, the bee is, *par excellence*, *the* ministering angel in their fruition. Let no one deny this. The man of experience, as well as the man of science, will contradict him if he does.

I have kept bees for 30 years, and have grown fruit and clover alongside for 30 years. I have also studied a little and experimented a little in this line as well as many other lines. As to some kinds of fruit—notably apples—I have observed that if, during the bloom, the weather was such that neither the winged insects nor the wind (being wet and cold) could perform their function with the flowers, the fruit was *non est*. When the weather at other times was favorable, and the bloom abundant, I have excluded the bees from certain portions of the tree, only to find the fruit also excluded—but only from those certain portions.

In the spring of 1892 I was summoned to appear before a legislative committee of the House of Assembly of Ontario, at Toronto, to give evidence as to the effects on the apiarian industry of spraying fruit-trees, while in bloom, with Paris green and other poisons. Our Ontario Bee-keepers' Association had moved for an act to prohibit the spraying while the trees were in bloom, as the bees were being poisoned in various places, and the spraying at such a time was unnecessary, and, indeed, injurious to the fruit as well as poisonous to the bees. The Minister of Agriculture, for the enlightenment and guidance of the legislative committee in a matter so important where the interests of the apiarists and horticulturists were alike involved, had summoned the leading men in both industries in the province to appear before the committee, to present the facts, the experiences, the pros and cons of both sides. The scientists were also summoned from Ottawa and Guelph—Dominion and Provincial entomologists — to speak for science. The questions of spraying, fertilization, etc., were discussed. The horticulturists, with one single exception, admitted the valuable and indispensable offices performed by the honey-bee in the fertilization of the fruit-bloom: and this was corroborated and confirmed by the entomologists. The fruit-growers agreed that "the bees play a very important part in cross-fertilization, and, therefore, should not be destroyed;" that "we are very generally dependent upon insects for the fertilization of our orchards. To destroy them to any extent would be very injurious to fruit growers."

Prof. James Fletcher, Dominion Entomologist, said, "Bees do not visit fruit-bloom in dull weather, and then we get little fruit in consequence." It may be well to quote Prof. Fletcher here on a cognate point also, as being a high authority. He said: "As to bees injuring fruit, there is no direct evidence. Wasps may start the work, and then bees continue it. We have never been able to find a case of primary injury *by bees*." (See official report of meeting.)

The consensus of the meeting was, that "bee-keepers and fruit-growers are of great help to each other, and even indispensable, if each class is to obtain the best results in their work."

The act we sought of the legislature became law in this Province, as follows: "No person, in spraying or sprinkling fruit-trees, during the period within which such trees are in full bloom, shall use or cause to be used any mixture containing Paris green or any other poisonous substance *injurious to bees*." The penalty clause follows, which I need not quote.

The two following facts are well established; viz., that bees perform an important and well-nigh indispensable function in the fertilization of fruit-bloom; and that, in order to properly protect the fruit from the ravages of destructive insects, it is not necessary to apply the poisonous remedies at a time when the bees will be injured thereby—that is, during full bloom, when the bees visit the trees for nectar. Darwin, Hilderbrand, Müller, and other naturalists, have, by their observations and experiments, placed these matters (of such prime importance to the bee-keeper) beyond question.

Selby, Ontario.

NECTAR FROM CORN-BLOSSOMS; DO STORMS WASH OUT THE POLLEN OR KEEP THE BEES AWAY FROM THE BLOSSOMS?

By E. H. Schaeffle.

I am pleased to see Mr. Doolittle championing the bee as the fertilizer of fruit-blossoms. Unfortunately these articles appear in bee-journals, where "the whole need no physician," for every bee-keeper is more than willing to credit the "blessed bees" with all the blessings man is heir to. It is the fruit-grower who needs educating, and, in consequence, the articles should be published in fruit-growers' journals.

For years past I have each year driven from fruit-ranch to fruit-ranch throughout the central and northern counties of this State, and have endeavored by tongue and pen, to correct the false impressions under which many of the fruit-growers labor; and it is surprising how ignorant these otherwise intelligent people are, and how bitterly they denounce the bee. Fortunately this prejudice is being removed, and the more intelligent orchardists now declare that the fruit-grower to be successful, must plant bees as well as fruit-trees if he would reap the greatest possible results, while the old fanatics,

> Once wedded fast,
> Hug their delusions to the last,

and can not be convinced that the bee and his keeper are other than two evils that should be legislated against, or by force driven out of existence.

Last spring I visited the Oak Leaf apiaries of Mr. S. L. Watkins, of Grizzly Flats, Cal. The profusion and diversity of bloom was simply wonderful; but the bees were not confined to